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FINAL REPORT ON  
INVESTIGATION OF THE PROPERTIES OF  
RADAR BACKSCATTER FROM SEA ICE

ONR CONTRACT N00014-85-K-0200

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THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.

2291 Irving Hill Road  
Lawrence, Kansas 66045-2969

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R. K. Moore

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## FINAL REPORT

Measurements of the radar backscatter from sea ice have been made during the years 1985-1988 using specialized radar scatterometers developed for the purpose. Most of the experiments during this period have involved artificial sea ice grown at CRREL, but measurements also were made during LIMEX in the Labrador Sea during March, 1989. We also analyzed data and published results from previous experiments conducted under ONR contract N00014-76-C-1105.

Much of the CRREL work involved use of a very-fine-resolution scatterometer to determine the sources of scattering from the ice and its overlying snow cover. Considerable insight into the mechanisms of scattering of radar signals from sea ice has resulted. Recently we have developed a polarimetric scatterometer capable of measuring the full scattering matrix, and this was used in two seasons of work at CRREL. Analysis of these data continues.

The results of this research have been and are being reported in published papers, conference reports, and oral presentations at conferences and workshops. A list of these is appended. These publications represent the essence of the reporting of this project, so this final report is short.

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PUBLICATIONS UNDER ONR CONTRACT N00014-85-K-0200

TECHNICAL REPORTS

- "Correction for Antenna Separation Using a Direct Integration Method," (D. Xue, R. K. Moore and T. H. Lee Williams), RSL Technical Report 3311-4, April 1986.
- "Final Report on Investigation of the Properties of Radar Backscatter from Sea Ice," (R. K. Moore, T. H. Lee Williams and R. G. Onstott), Remote Sensing Laboratory Technical Report 3311-5, August 1985.
- "University of Kansas MIZEX 84 In Situ Radar Backscatter Data Record," (P. F. Blanchard, R. K. Moore, S. P. Gogineni and R. G. Onstott), RSL Technical Report 3311-6, May 1987.
- "Investigation of Radar Backscattering from Second-Year Sea Ice," (G. Lei, R. K. Moore and S. P. Gogineni), RSL Technical Report 3311-7, February 1988.
- "CRREL 88 Experiment Report," (J. Bredow, S. P. Gogineni and L. Tee), RSL Technical Report 3311-8, March 1988.
- "Final Report on Investigation of the Properties of Radar Backscatter from Sea Ice, ONR Contract N00014-85-K-0200," (R. K. Moore), RSL Technical Report 3311-9, September 1989.

TECHNICAL MEMORANDA

- "An In-Situ Probe for Dielectric Constant Measurement," (J. Jiang, R. K. Moore, R. G. Onstott and S. Gogineni), RSL Technical Memorandum 331-34, January 1984.

JOURNAL ARTICLES

- "Active Microwave Measurements of Arctic Sea Ice Under Summer Conditions," (R. G. Onstott and S. P. Gogineni), J. Geophys. Res., vol. 90, no. C3, pp. 5035-5044, May 1985.
- "Towards Identification of Optimum Radar Parameters for Sea-Ice Monitoring," (Y. S. Kim, R. K. Moore, R. G. Onstott and S. P. Gogineni), Journal of Glaciology, vol. 31, no. 109, pp. 214-219, 1985.
- "Microwave Sea Ice Signatures Near the Onset of Melt," (C. E. Livingstone, R. G. Onstott, L. D. Arsenault, A. L. Gray and K. P. Singh), Geos. & Remote Sensing, vol. GE-25, no. 2, pp. 174-187, March 1987.

#### PUBLISHED CONFERENCE RECORDS

- "Active Microwave Measurements of Artificially Grown Sea Ice," (R. G. Onstott, D. Xue, R. K. Moore and R. W. Larson), Digest IGARSS'85, IEEE 85CH2162-6, Amherst, MA, 7-9 October 1985, p. 175.
- "Active Microwave Properties of Sea Ice in the Marginal Ice Zone," (R. G. Onstott and R. K. Moore), Digest IGARSS'85, IEEE 85CH2162-6, Amherst, MA, 7-9 October 1985, p. 444.
- "Radar Backscatter from Sea Ice," (S. P. Gogineni, R. K. Moore, G. Shirtliffe and R. G. Onstott), Proceedings of the 1986 National Radar Conference, Los Angeles, CA, 12-13 March 1986, pp. 107-114.
- "Microwave Backscatter Coefficients of Artificially Grown First Year Sea Ice," (D. Xue, R. K. Moore, T. H. Lee Williams and R. G. Onstott), presented at the International IEEE AP-S Symposium and National Radio Science Meeting, Philadelphia, PA, June 9-13, 1986, and Digest IGARSS'86, IEEE 86CH2268-1, ESA SP-254, Zurich, Switzerland, 8-11 September 1986, pp. 139-146.
- "A Fine-Resolution Multifrequency Polarimetric FM Radar," (J. Bredow, S. Gogineni, T. Leung and R. K. Moore), Digest IGARSS'88, IEEE 88CH2497-6, ESA SP-284, Edinburgh, Scotland, 13-16 September 1988, pp. 327-329.
- "Active Microwave Measurements of Artificial Sea Ice," (J. Bredow, S. P. Gogineni, R. G. Onstott and S. Gaboury), Digest IGARSS'88, IEEE 88CH2497-6, ESA SP-284, Edinburgh, Scotland, 13-16 September 1988, pp. 805-807.

#### CONFERENCE PRESENTATIONS

- "Radar Backscatter from Sea Ice During Summer," (S. P. Gogineni, R. K. Moore and R. G. Onstott), presented at the 1985 North American Radio Science Meeting and International IEEE/AP-S Symposium, Vancouver, Canada, 17-21 June 1985.
- "A Review of Radar Experiments in Monitoring Sea Ice," (R. K. Moore), presented at the URSI International Symposium on Microwave Signatures in Remote Sensing, Gothenburg, Sweden, 19-22 January 1987.